

What is claimed is:

1. A method for forming a thin film on a substrate comprising:
simultaneously providing reactants at a surface of a substrate disposed in a chamber;
5 sequentially providing energies to the reactants to separately activate molecules of the
reactants; and
depositing the activated molecules on the surface of the substrate to form a thin film.

2. The method according to claim 1, wherein simultaneously providing reactants
10 and sequentially providing energies to the reactants comprises:

providing a first energy to the reactants to selectively activate a first reactant among the
reactants;

depositing the activated first reactant on the surface of the substrate to form a
chemisorbed layer;

15 providing a second energy to the reactants comprising the first chemisorbed layer to
increase the temperature of the surface of the first chemisorbed layer; and

depositing a second reactant among the reactants on the first chemisorbed layer to form
the thin film.

20 3. The method according to claim 2, further comprising providing a third energy to
selectively activate the thin film.

4. The method according to claim 2, wherein the temperature of the reactants
comprising the first chemisorbed layer is lower than a dissociation temperature of a subsequent
25 material deposited on the first chemisorbed layer.

5. The method according to claim 2, wherein the thin film is a first thin film, the method further comprising:

providing a third energy to the reactants comprising the first thin film to increase the temperature of the first thin film;

depositing a third reactant among the reactants on the first thin film, the temperature of which has been increased, to form a second chemisorbed layer;

providing a fourth energy to the reactants comprising the second chemisorbed layer to increase the temperature of the second chemisorbed layer; and then

depositing a fourth reactant among the reactants on the second chemisorbed layer to form a second thin film on the first thin film.

6. The method according to claim 5, further comprising providing energies to the third and fourth reactants to activate the second thin film.

7. The method according to claim 5, wherein a surface of the reactants comprising the second thin film has a temperature lower than a dissociation temperature of a material of the second thin film.

8. The method according to claim 2, wherein activating the first reactant comprises colliding, vibrating and/or rotating the molecules of the first reactant.

9. The method according to claim 2, wherein the first or second energy comprises an alternating current field and/or a light energy.

10. The method according to claim 9, wherein the first or second reactant has a polarity when the first or second energy comprises the alternating current field.

11. A method for forming a thin film on a substrate comprising:

5 introducing a first reactant into a chamber;

providing a first energy to the first reactant to activate the first reactant;

depositing the activated first reactant on the substrate to form a chemisorbed layer;

exhausting the first reactant remaining in the chamber;

introducing a second reactant to the chamber;

10 providing a second energy to the chemisorbed layer to increase the temperature of the reactants comprising the chemisorbed layer; and then

depositing the second reactant on the chemisorbed layer to form a thin film on the substrate.

15 12. The method according to claim 11, further comprising providing a third energy to a surface of the substrate to activate materials on the substrate.

13. The method according to claim 11, wherein the temperature of the reactants comprising the chemisorbed layer is lower than a dissociation temperature of the reactants
20 deposited on the chemisorbed layer.

14. The method according to claim 11, wherein the thin film is a first thin film, the method further comprising:

exhausting the second reactant remaining in the chamber;

25 introducing a third reactant;

providing a third energy to the first thin film to increase the temperature of the reactants comprising the first thin film;

depositing a third reactant on the first thin film, the temperature of which has been increased, to form a second chemisorbed layer;

5 exhausting the third reactant remaining in the chamber;

introducing a fourth reactant;

providing a fourth energy to the second chemisorbed layer to increase the temperature of the reactants comprising the second chemisorbed layer;

10 depositing the fourth reactant on the second chemisorbed layer, the temperature of which has been increased, to form a second thin film on the first thin film; and

exhausting the fourth reactant remaining in the chamber.

15 15. The method according to claim 14, further comprising providing a fifth energy to the third and fourth reactants to activate the reactants comprising the second thin film.

20 16. The method according to claim 14, further comprising repeatedly performing exhausting the second reactant, introducing the third reactant, providing the third energy, depositing the third reactant, exhausting the third reactant, introducing the fourth reactant, providing the fourth energy, and depositing the fourth reactant and exhausting the fourth reactant to form a multi-layer film.

25 17. The method according to claim 11, wherein the temperature of the surface of the chemisorbed layer is lower than a dissociation temperature of the reactants deposited on the substrate.

18. The method according to claim 11, wherein activating the first reactant comprises colliding, vibrating and/or rotating the molecules of the first reactant.

19. The method according to claim 11, wherein the first or second energy comprises
5 an alternating current field and/or a light energy.

20. The method according to claim 21, wherein the first or second reactant has a polarity when the first or second energy comprises the alternating current field.

21. A method for forming a thin film on a substrate in a chamber comprising:
10 introducing a first reactant to a polar surface of a substrate in a deposition chamber;
providing a first energy to the substrate to increase the temperature of the substrate;
providing a second energy to the first reactant to activate the first reactant;
depositing the first reactant on the surface of the substrate to form a first chemisorbed
15 layer;
exhausting the first reactant remaining in the chamber;
providing a second reactant to the chamber;
providing a third energy to the reactants comprising the first chemisorbed layer to
increase the temperature of the reactants comprising the first chemisorbed layer;
20 providing a fourth energy to the second reactant to activate the second reactant; and then
depositing the second reactant on the first chemisorbed layer to form a thin film on the
substrate.

22. The method according to claim 9, wherein the alternating current field or light
25 energy is produced by a microwave or an infrared ray.

23. The method according to claim 19, wherein the alternating current field or light energy is produced by a microwave or an infrared ray.

5 24. The method according to claim 5, wherein the third or fourth energy comprises an alternating current field and/or a light energy.

25. The method according to claim 14, wherein the third or fourth energy comprises an alternating current field and/or a light energy.

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26. The method according to claim 23 further comprising repeatedly performing introducing the second reactant, providing the third energy, providing the fourth energy, and depositing the second reactant to form a multi-layer film.